

ISOLATED PARALYSIS OF THE SERRATUS ANTERIOR

A REPORT OF 20 CASES

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A description is given of 20 patients with winging of the scapula. The majority had suffered spontaneous severe pain in the region of the shoulder followed about two weeks later by the deformity and associated loss of function. Only in three patients was there a clear history of trauma. Some patients may have strained the arm, but in the majority no single factor heralded the problem.

Most of the patients were followed up for more than two years and it became clear that functional recovery could take up to this time to be complete. However, careful examination revealed that often a slight degree of winging remained. No specific treatment apart from gentle physiotherapy was prescribed and certainly no operative procedures. It is considered that a number of these cases were examples of neuralgic amyotrophy.

Classical winging of the scapula is due to paralysis of the serratus anterior muscle which is supplied by the long thoracic nerve. This is a tidy anatomical unit, one motor nerve (arising from three cervical roots, C5, 6, 7), one muscle to supply and one main function for that muscle, namely to hold the scapula against the chest wall during movements of the shoulder joint. Paralysis of the muscle causes not only winging of the scapula but also results in lack of stabilisation and proper scapular rotation. This precludes normal movement of the shoulder and abduction is markedly limited. The patient may complain of an ugly prominence of the shoulder blade which tends to be uncomfortable when in contact with a hard surface, of weakness when lifting the arm and of considerable discomfort after repeated effort.

A number of accounts of the condition have appeared in both the orthopaedic and the medical literature since the condition was first described by Velpeau (1837). Horwitz and Tocantins (1938a) described six cases all of which seemed to have a traumatic origin. Johnson and Kendall (1955) reviewed the 111 cases which had been reported in the orthopaedic literature up to that time and added 20 of their own. The aetiology of these were placed under the following headings: acute trauma 37, recurrent trauma 21, following infections 16, post partum 7, following injections 12, following associated and unrelated surgical operations 7, following exposure to cold 13, and idiopathic 18. Unfortunately,

only half of their cases were followed up and these for only six months. However, in terms of aetiology their range of causes to some extent matches our own although they give no credence to neuralgic amyotrophy which may well have accounted for their non-traumatic cases.

More recently Gregg *et al.* (1979) reported winging of the scapula in a select series of 10 sportsmen and the cause was attributed to tennis. The average recovery time was nine months but the point was made that although functional recovery was good, careful examination revealed slight residual weaknesses. Goodman, Kenrick and Blum (1975) reporting 12 cases described a similar scatter of aetiology, five traumatic, four infective and three idiopathic; they also commented that compensatory movements aided functional recovery.

The majority of accounts of winged scapula have given lists of aetiological headings such as trauma, infections, idiopathic, without attempting to elucidate how these factors could operate to produce an interruption of the long thoracic nerve, thus paralysing the serratus anterior muscle. However, two main streams of thought have emerged: first, trauma, and by this is meant abnormal pressure on the nerve at some point or possibly a traction injury, either as an isolated event or repeated as in athletic events; secondly, that those cases following infections or childbirth and the idiopathic group are suffering from a manifestation of neuralgic amyotrophy.

In support of the theory that the anatomical course of the long thoracic nerve made it specially vulnerable, Horwitz and Tocantins (1938b) dissected the nerve in 100 cadavers. In the majority, the contributions from the cervical roots which combined to form the main trunk traversed the scalenus medius and emerged from its lateral side. They suggested that spasm of this muscle might interrupt conduction of these nerve roots, so causing the paralysis. It is evident that this is unlikely

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Table I. Summary of 20 patients with isolated paralysis of the serratus anterior

Case	Age (years)	Sex	Dominant limb	Affected side	Presentation	Attributed cause	Pain to palsy interval	Occupation	Treatment	Recovery time	Investigations	Follow-up period
1	35	F	R	R	Pain	Wrenched arm	5 weeks	Typist	Physiotherapy	Complete at 2 years	Radiograph of chest and thoracic outlet	4 years
2	33	F	R	R	Severe pain	Post partum	2 weeks	Actress	Nil	Complete at 1 year	None	10 years
3	30	F	R	R	Severe pain	None	8 weeks	Housewife	Nil	Complete at 1 year	None	6 years
4	66	F	R	R	Severe pain	None	6 weeks	Clerk	Nil	Complete at 1 year	None	8 years
5	50	F	R	R	Severe pain	Hedge clipping	1 week	Housewife	Nil	Complete at 1 year	None	6 years
6	35	M	R	R	Severe pain	None	4 weeks	Watch-maker	Nil	Complete at 18 months	Radiograph of neck and thoracic inlet	8 years
7	38	F	R	R	Inability to raise arm	None	N/A	Housewife	Physiotherapy	Complete at 6 months	None	8 years
8	41	M	R	R	Winging	None	N/A	Butcher	Nil	* Complete at 2 years	None	2 years
9	22	M	R	R	Severe pain	None	2 weeks	Policeman	Nil	* Complete at 1 year	None	2 years
10	70	M	R	R	Pain	None	10 days	Retired	Nil	Complete at 6 months	Radiographs of chest and neck	4 years
11	52	F	R	R	Severe pain	None	10 weeks	Housewife	Nil	Complete at 2 years	Radiograph of neck	7 years
12	28	M	R	R	Severe pain	Winding machinery	4 weeks	Mechanic	Nil	* Complete at 6 months	None	3 years
13	18	M	R	R	Severe pain	Tennis	3 weeks	Student	Nil	* Complete at 1 year	None	12 years
14	25	M	R	R	Severe pain	None	2 months	Civil engineer	Physiotherapy	None at 6 months	Radiograph of shoulder and thoracic inlet; ESR	Lost to follow-up
15	46	F	R	R	Severe pain	Old accessory nerve injury	2 weeks	Housewife	Nil	Insufficient follow-up at 6 months	None	6 months
16	36	M	R	R	Pain	Digging	2 weeks	Office worker	Nil	Insufficient follow-up at 9 months	None	9 months
17	44	F	R	L	Severe pain	Influenza	1 week	Housewife	Physiotherapy	* Complete at 6 months	None	1 year
18	39	F	R	R	Pain	Drug overdose	1 week	Clerk	Physiotherapy	No recovery at 3 months	None	Lost to follow-up
19	30	F	R	R	Pain	None	2 weeks	Housewife	Nil	Unknown	Radiograph of shoulder and neck	Lost to follow-up
20	25	F	R	R	Severe pain	Archery	10 days	Clerk	Nil	Unknown	None	Lost to follow-up

* These patients had full functional recovery including a full range of abduction, but close examination revealed slight residual winging when they pushed forwards against resistance
N/A, not applicable



Fig. 1



Fig. 2



Fig. 3

Case 16. Figure 1—The shoulders at rest. Figure 2—Winging apparent when the patient is pushing forward. Figure 3—Attempting full abduction.

because a similar neuromuscular relationship occurs in many other anatomical sites without ill effect; moreover, the rhomboid muscle is not affected concurrently, which it would be if root conduction were interrupted. Angulation of the nerve trunk as it crossed the second rib emerged as a possibility. Distraction of the shoulder from the neck in their specimens tightened the nerve, but since the nerve is long (its length averages 24 centimetres) it must be capable of a reasonable amount of stretching without damage; this is borne out by the fact that traction injuries of the brachial plexus are not invariably accompanied by injury to the long thoracic nerve. The same authors went on to suggest that, if the scapula is forced medially, the nerve might be compressed between the coracoid process and the second rib, particularly in cases where the nerve roots emerged from the posterior border of the scalene muscle. Finally, the close association of the nerve with the subscapular and subcoracoid bursae led to the suggestion that local pressure might arise if these bursae were swollen or inflamed.

The probability that paralysis of the serratus anterior can be a manifestation of neuralgic amyotrophy has received scant attention in the orthopaedic literature. The term neuralgic amyotrophy was coined by Parsonage and Turner in 1948 to describe the shoulder-girdle syndrome or paralytic brachial neuritis. They described cases in 136 military personnel with various manifestations of the shoulder-girdle syndrome, 30 of whom had isolated paralysis of the serratus anterior. Later the same authors (Turner and Parsonage 1957) studied the prognosis in 82 patients of whom 28 had isolated winging of the scapula. This report matched our own findings in two respects, namely that in 25 of their 28 patients the right scapula was affected and also that recovery took up to two years. An even earlier report by Spillane (1943) recorded 13 cases of serratus palsy in fit servicemen.

In an endeavour to locate the site of the neural lesion, biopsy studies of the long thoracic nerve have been carried out which have shown diffuse axonal degeneration (Tsairis, Dyck and Mulder 1972); this has been confirmed by electromyographic studies which

showed a reduction in amplitude of sensory action potentials with normal motor conduction velocities. O'Brien and Payan (1980) found in some cases that when Erb's point was stimulated there was a pronounced increase in distal motor latency which implied demyelination in addition to axonal degeneration. Clinical presentation and electromyographic studies led Devathasan and Tong (1980) to a confident diagnosis in 21 patients suffering from the condition and hence to their reassurance of full or partial recovery.

Two editorials in the *Lancet* within a decade (1974, 1980) have emphasised the importance of neuralgic amyotrophy and summarised our present knowledge. The differential diagnosis includes poliomyelitis, motor neuron disease, diabetic amyotrophy, spinal muscular atrophy, muscular dystrophy and cervical spondylosis. However, the clinical picture of neuralgic amyotrophy is characteristic, with its spontaneous and painful onset leaving flaccid paralysis after about two weeks, then proceeding to an acceptable degree of recovery within two years. In a significant number of cases it is confined to the nerve to the serratus anterior. The unexplained features which emerge from the literature are the aetiology, the predilection for the upper branches of the brachial plexus, and the right-sided predominance, even in left-handed people.

CLINICAL MATERIAL

In this article we present a series of 20 patients who were referred to the orthopaedic department of Heatherwood Hospital between 1970 and 1982. The numbers of men and women were almost equal, and their age range was 18 to 70 years. All patients were right-handed including the patient whose left side was affected (Case 17). Their details are given in Table I.

RESULTS

Natural history. Typically the patient develops a very severe pain around the right shoulder; this appears to be spontaneous in onset although, in a few patients,

retrospective questioning may suggest some unaccustomed activity such as hedge clipping. The patients are well in themselves but, as the pain subsides after about two weeks, they are left with a winged scapula. Attention is drawn to this by the cosmetic appearance or by weakness of the shoulder (Figs 1 to 3). Radiographs of the neck, chest, shoulder and thoracic inlet have been done in a number of these patients but no abnormality has been detected.

Over the course of the next few months function improves and the protrusion of the scapula lessens. Recovery, however, may take up to two years and even then close questioning and careful physical examination may reveal slight residual palsy. Some patients still complain of discomfort from the medial border of the scapula when leaning back against a hard chair; the only residual complaint of a mechanic was that his shoulder blade was uncomfortable when he lay on his back under a car. In this particular patient (Case 12) all other aspects of function were normal, although on physical examination slight residual weakness could be detected.

Precipitating cause. One patient wrenched her arm when falling down stairs, one took an overdose and was unconscious for some hours, another associated the onset with a bad attack of influenza, and one patient developed the problem after childbirth. In one unusual case the accessory nerve had been divided at operation many years before the serratus palsy developed; the subsequent dropping of her scapula probably caused traction on the long thoracic nerve. Thus, five cases had possible closely associated precipitating causes, three of which were traumatic. Five patients thought their problems arose from repetitive trauma such as tennis (Case 13), or archery (Case 20), although these associations were by no means convincing since they practised these sports regularly. Ten patients could give absolutely no possible cause, and these we attributed to neuralgic amyotrophy.

In 13 patients the pain at onset was described as severe or excruciating, often keeping them awake; in five patients it was moderate, while two experienced no pain and in them the winging of the scapula was unheralded. In all patients the pain soon disappeared completely and it was only after it had gone that the palsy became evident; it was noticed between 1 and 10 weeks from the onset of the pain, with an average time of two and a half weeks.

Follow-up has ranged from six months to 12 years. In view of the natural history of the condition follow-up of less than two years must be deemed insufficient in those patients who have not recovered. Thirteen patients have been followed up for more than two years. In those that have been followed for considerably longer, no further recovery has ensued. Thus, it appears that recovery can take up to two years but after that no further improvement occurs. While functional recovery may be good and totally acceptable, close examination may reveal slight residual winging and this was so in five patients. This concurs with the electromyographic studies performed by Fardin, Negrin and Dainese (1978).

DISCUSSION

While there are a number of patients who develop winging of the scapula as a result of trauma, there are others where the condition arises *de novo* and can be attributed to neuralgic amyotrophy. This condition can affect any nerve in the upper limb and may possibly be caused by a virus infection (*Lancet* 1980.) It is characterised by severe pain experienced at the onset; in some cases one particular nerve such as the long thoracic, is affected. Whatever the aetiology, these patients commonly recover spontaneously in large measure within two years of onset. A number of extensive (but in our view inappropriate) procedures for treatment are described in the orthopaedic literature: examples are quoted by Whitman (1932), Rapp (1954) and Goodman *et al.* (1975). These have more application to conditions such as poliomyelitis where the paralysis may not recover, than to the benign condition we are discussing.

The wearing of a scapular brace has been suggested, but we found this to be cumbersome and not appreciated by the patient. Physiotherapy may encourage use of the arm but there is a danger of over-stretching the paralysed muscle.

Having eliminated other causes of winging of the scapula, such as poliomyelitis or scoliosis, the orthopaedic surgeon should be in a position to reassure the patient that good functional recovery may be expected within two years and that no treatment is indicated.

It is a remarkable coincidence that the long thoracic nerve of Bell should suffer from a similar affliction to the facial nerve where the paralysis is known as Bell's palsy.

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